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PATENT APPLICATION

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IN THE
UNITED STATES PATENT AND TRADEMARK OFFICE

Inventor(s): Qingqiao Wei

Confirmation No.: 5174

Application No.: 10/807932

Examiner: Brian J Sines

Filing Date: Mar 23, 2004

Group Art Unit: 1797

Title: Fluid Sensor And Methods

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Commissioner For Patents
PO Box 1450
Alexandria, VA 22313-1450

## TRANSMITTAL OF APPEAL BRIEF

Transmitted herewith is the Appeal Brief in this application with respect to the Notice of Appeal filed on July 13, 2009

☒ The fee for filing this Appeal Brief is $540.00 (37 CFR 41.20).

☐ No Additional Fee Required.

**(complete (a) or (b) as applicable)**

The proceedings herein are for a patent application and the provisions of 37 CFR 1.136(a) apply.

☐ (a) Applicant petitions for an extension of time under 37 CFR 1.136 (fees: 37 CFR 1.17(a)-(d)) for the total number of months checked below:

| ☐ 1st Month $130 | ☐ 2nd Month $490 | ☐ 3rd Month $1110 | ☐ 4th Month $1730 |
|---|---|---|---|

☐ The extension fee has already been filed in this application.

☒ (b) Applicant believes that no extension of time is required. However, this conditional petition is being made to provide for the possibility that applicant has inadvertently overlooked the need for a petition and fee for extension of time.

Please charge to Deposit Account 08-2025 the sum of $ 540 . At any time during the pendency of this application, please charge any fees required or credit any over payment to Deposit Account 08-2025 pursuant to 37 CFR 1.25 Additionally please charge any fees to Deposit Account 08-2025 under 37 CFR 1.16 through 1.21 inclusive, and any other sections in Title 37 of the Code of Federal Regulations that may regulate fees

Respectfully submitted,

Qingqiao Wei

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**IN THE UNITED STATES PATENT AND TRADEMARK OFFICE**

| | |
|---|---|
| First named Applicant:<br>QingGiao Wei<br><br>Application No.: 10/807932 (CONF 5174)<br><br>Filed: March 23, 2004<br><br>Title: Fluid Sensor and Methods<br><br>Attorney Docket No.: 200314202-1 | Group Art Unit:<br>1797<br><br><br><br><br>Examiner:<br>Brian J Sines |

Assistant Commissioner for Patents
Washington, D.C. 20231

APPEAL BRIEF

This Appeal Brief is organized in accordance with the requirements set forth in 37 CFR 41.37(c).

Real party in interest

The real party in interest is Hewlett-Packard Development Company, LP, a limited partnership established under the laws of the State of Texas and having a principal place of business at 20555 S.H. 249 Houston, TX 77070, U.S.A. (hereinafter "HPDC"). HPDC is a Texas limited partnership and is a wholly-owned affiliate of Hewlett-Packard Company, a Delaware Corporation, headquartered in Palo Alto, CA. The general or managing partner of HPDC is HPQ Holdings, LLC.

Related appeals and interferences

There are no related appeals or interferences to the present patent application.

Status of claims

Claims 1-3, 6-10, 14, 15, 17 18, 20-24, 27, 29-31 and 56-59 are pending in the patent application, and all stand rejected. The rejection of all the pending claims 1-3, 6-10, 14, 15, 17 18, 20-24, 27, 29-31 and 56-59 is being appealed herein, and therefore all the pending claims 1-3, 6-10, 14, 15, 17 18, 20-24, 27, 29-31 and 56-59 are subject to this appeal.

Status of amendments

Amendments were made to the claims in the office action response of January 22, 2009 which were then entered by the Examiner in the next office action of March 25, 2009. As such, there are no non-entered amendments pending to the claims. As to the status of any amendments filed subsequent to the final rejection of the claims, no such amendments were filed.

Summary of claimed subject matter

There are two independent claims, claims 1 and 56, pending in the present patent application. For ease of appeal, only claims 1 and 56 will be argued.

*Claim 1*

Claim 1 is directed to a fluid sensor (Figs 1-7, and page 4:16 to page 10:13) on a substrate 20 for use in an environment that has an ambient temperature. The fluid sensor includes a field effect transistor (FET) 15 that this disposed on the substrate 20. The FET 15 includes a functionalized semiconductor nano-wire 100 having at least one catalyst 80 (see page 12:3-13 and page 13:28-31) of a material capable of interacting with a fluid to be sensed and which effectuates a change of an electrical characteristic of the FET 15. A control device 120 (page 8:4-7) on the substrate has a non-functionalized semiconductor nano-wire otherwise identical to the FET 15. An integral heater 110 is disposed proximate to the FET 15 to heat the FET 15 to an elevated temperature relative to the ambient temperature. An integral temperature sensor 150, 155 on the substrate 20 is configured to allow control and selection of temperatures for at least one of calibration and setting of gas sensitivity. An integral thermal insulation 30 is disposed on the substrate 20 to maintain the FET 15 at the elevated temperature. By selection of the FET 15 operating temperature by measurement of the temperature sensor 150,155 a particular fluid may be detected.

*Claim 56*

Claim 56 is also directed to a fluid sensor (Figs 1-7, and page 4:16 to page 10:13) on a substrate 20 for use in an environment having an ambient temperature. The fluid sensor includes a field effect transistor (FET) 15 that includes a functionalized semiconductor nano-wire 100 having at least one coating, the coating (see page 12:3-13 and page 13:28-31) including a substance capable of interacting with a fluid to be sensed and that effects a change of an electrical characteristic of the FET 15. A control device 120 on the substrate has a non-functionalized semiconductor nano-wire otherwise identical to the FET 15. An integral heater 110 is disposed proximate to the FET 15 to heat the FET 15 to an elevated temperature relative to the ambient temperature. An integral temperature sensor 150, 155 is configured to allow control and selection of temperatures for at least one of calibration and setting of gas sensitivity. An integral thermal insulation 30 is disposed on the substrate to maintain the FET 15 at the elevated temperature. By selection of the FET operating temperature by measurement of the integral temperature sensor 150, 155, a particular fluid may be detected.

Grounds of rejection to be reviewed on appeal

For the purposes of this appeal, there is one ground of rejection to be reviewed on appeal: whether the pending claims 1-2, 6-10, 14-15, 17-18, 20-24, 27, 29-31, and 56-59 are properly rejected under 35 USC 103 as obvious over Kendall et al. (USP 6, 509,619, hereafter "Kendall") in view of Briand et al. (Journal of Microelectromechanical Systems, vol. 9. No. 3, Sept. 2000, hereafter "Briand").

Argument

Applicant's argument is that one of ordinary skill in the art would not combine Briand with Kendall without the Applicant's disclosure as a template for doing so as both Kendall and Briand have teachings for detecting gases or fluids which would lead one away from doing the fluid detection in the manner claimed, disclosed and described by the Applicant. It is the

Examiner's combining of the various features in Applicant's claim from each of the references without taking into account the "invention as a whole" or reflecting on whether one could actually modify Kendall with Briand's teachings to create Applicant's invention without looking at the disclosures as a whole for all that they teach.

Claim 1 has the limitation of having "at least one catalyst" and claim 56 has the limitation of "at least one coating." Both claim 1 and 56 include a field effect transistor (FET) in which the "catalyst" or "coating" are "capable of interacting with a fluid to be sensed and effecting a change of an electrical characteristic of the FET." Accordingly, the discussion below includes arguments for both claim 1 and 56 as the other limitations are similar.

Applicant discloses and teaches (pages 8:21-9:8) that an integral temperature sensor 150 (and/or 155) allows "control and selection of temperatures for calibration purposes and for setting gas sensitivity." This limitation is included in claims 1 and 56 as "an integral temperature sensor on the substrate configured to allow control and selection of temperatures for at least one of calibration and setting of gas sensitivity." On page 3 of the Office Action (3/25/09), the Examiner states that "Kendall is silent about the device" of "at least one integral temperature sensor on the substrate." The Examiner then asserts that Briand has a temperature sensor and integral heater and that it "is desirable to provide an integral heater and temperature sensor because it provides a way to control the operating temperature of the sensor." However, Briand discloses only using the integral heater to heat the gas sensors to *typical operating temperatures* at about 140 °C and 170 °C (see Briand page 305, second column, first partial paragraph and first full paragraph) and that the actual selection of gas sensitivity is performed by having the "GasFets having three different catalytic metals." Contrarily, Applicant teaches (page 8:21-30) that with the appropriate catalyst the FET 15 sensor may be more sensitive to a gas A and less sensitive to a gas B at 100C and more sensitive to a gas B and less sensitive to a gas A at 200 C. Thus, the Applicant is using the ability to calibrate a sensor to detect different gases by operating the sensor using different temperatures to detect the gases rather than having different catalytic metals do the selection. Accordingly, Briand operates the sensors only at typical operating

temperatures required for operation but selects the individual gases by having different catalytic metals on each sensor.

It is the Applicant's insight and enablement of how to perform such a temperature based selection of various gases with a sensor using the same catalyst that distinguishes the inventive step over Briand. Combining Briand with Kendall does not produce the Applicant's claimed sensor. In fact, Briand acknowledges it does not do so. On page 306, second column, first partial paragraph, Briand states; "Further investigations are needed to evaluate the effect of different temperature profiles during the gas measurements in the aim of improving the gas sensitivity and selectivity. More measurements need to be performed before a conclusion can be drawn about the way the signal from the reference sensor can be used." Accordingly, Briand does not enable Applicant's claimed invention. Briand doesn't even know if his sensor is capable of such operation or that even a more sensitive type of sensor will be required such as Applicant's FET with a functionalized semiconductor nano-wire with either a catalyst (claim 1) or other coating (claim 56).

Further, Kendall does not suggest looking to Briand as Kendall uses the oxide thickness as an adjustment to detect different size and shaped molecules (col. 9, lines 21-23). Kendall doesn't suggest doing it otherwise. In fact, Kendall is using nano-wires to make atomic ridges (col. 5, lines 45-59) which are used to provide grooves in the substrate in which long chain molecules are deposited (col. 8, lines 45-51) . The nano-wires can even be removed from Kendall (col. 5, lines 60-65). Kendall does not have a "functionalized semiconductor nano-wire" but really has "at least one elongated molecule located in at least one of the nanogrooves" (see abstract and Fig. 3). It is the Applicant's insight of using a control sensor along with calibration of the control sensor and gas sensors over temperature along with the functionalized semiconductor nano-wire in both the both control sensor and FET sensor to get the required sensitivity that changes an electrical characteristic of the FET sensor sufficient to distinguish different gases over a temperature range rather than using the different catalysts of Briand or oxide thicknesses of Kendall. Accordingly, Kendall does not teach or disclose using the

temperature along with the sensitivity of nano-wires to perform the gas sensitivity selection. Also, while the Examiner asserts that Kendall discloses that the membranes may be heated and cooled in incredibly short times (OA, page 2, 4th and 3rd lines from bottom), Kendall is actually describing such an effect in terms of using the gas sensor as a environmental or flow sensor. That is, it would be used to detect rapid changes in the gas levels or speeds, respectively. It does not suggest that the increased sensitivity be used to detect different gases at different temperature profiles such as to "allow control and selection of temperatures for at least one of calibration and setting of gas sensitivity." Accordingly, there is no teaching, disclosure, or suggestion that would motivate one of ordinary skill in the art to combine the nano-wires of Kendall with the teachings of Briand to arrive at the Applicant's claimed invention, particularly, that of using the combination of *nano-wires*, temp-sensors, heaters, and reference sensors to create a gas sensor that can *detect various gases based on changing the temperature of a FET with a functionalized semiconductor nano-wire*. Withdrawal of the 103(a) rejection for all of the remaining claims is respectfully requested.

Respectfully Submitted,

September 10, 2009
Date

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Claims appendix

1. (Previously Presented) A fluid sensor on a substrate for use in an environment having an ambient temperature, the fluid sensor comprising:

a) a field-effect transistor (FET) disposed on the substrate comprising a functionalized semiconductor nano-wire, the functionalized semiconductor nano-wire including at least one catalyst, the catalyst comprising a material capable of interacting with a fluid to be sensed and effecting a change of an electrical characteristic of the FET,

b) a control device on the substrate comprising a non-functionalized semiconductor nano-wire otherwise identical to the FET,

c) an integral heater disposed proximate to the field-effect transistor to heat the field-effect transistor to an elevated temperature relative to the ambient temperature,

d) an integral temperature sensor on the substrate configured to allow control and selection of temperatures for at least one of calibration and setting of gas sensitivity; and

e) integral thermal insulation disposed on the substrate to maintain the field-effect transistor at the elevated temperature wherein selection of the FET operating temperature by measurement of the integral temperature sensor, a particular fluid may be detected.

2. (Original) The fluid sensor of claim 1, wherein the functionalized semiconductor nano-wire comprises silicon.

3. (Previously Presented) The fluid sensor of claim 1, wherein the functionalized semiconductor nano-wire is doped to provide a predetermined conductivity type.

Claims 4-5 (Cancelled).

6. (Previously Presented) The fluid sensor of claim 1, wherein the catalyst comprises a metallic catalyst.

7. (Previously Presented) The fluid sensor of claim 1, wherein the catalyst is a material selected from the list consisting of platinum, palladium, iridium, rhenium, ruthenium, gold, silver, and mixtures or alloys or compounds thereof; carbon; tungsten, titanium, tin, zinc, and oxides thereof; organometallic compounds containing elements from the group consisting of cobalt, iron, and nickel; and transition metal complexes containing elements from Groups IIIA, IVA, VA, VIA, VIIA, VIIIA, IB, IIB of the Periodic Table of Elements.

8. (Previously Presented) The fluid sensor of claim 1, wherein the catalyst comprises a porous thin layer of catalyst material.

9. (Original) The fluid sensor of claim 8, wherein pores of the porous thin layer of catalyst material extend at least partially through the thin layer of catalyst material.

10. (Previously Presented) The fluid sensor of claim 1, wherein the catalyst comprises a mesh formed by thin filaments of catalyst material.

Claims 11-13 (Cancelled).

14. (Previously Presented The fluid sensor of claim 1, wherein the field-effect transistor and the substrate are formed from a layer of silicon on an insulator (SOI).

15. (Original) The fluid sensor of claim 14, wherein the field-effect transistor and the substrate are formed from a layer of silicon on an insulator layer comprising silicon oxide.

16. (Cancelled).

17. (Previously Presented) The fluid sensor of claim 1, wherein the integral heater is disposed on the substrate.

18. (Previously Presented) The fluid sensor of claim 1, wherein the integral heater is disposed on the integral thermal insulation.

19. (Cancelled).

20. (Previously Presented) The fluid sensor of claim 1, wherein the field-effect transistor (FET) is disposed on the integral thermal insulation.

21. (Previously Presented) The fluid sensor of claim 1, wherein a portion of the substrate is removed to form an opening under the field-effect transistor (FET), the opening being at least partially aligned with the field-effect transistor.

22. (Previously Presented) The fluid sensor of claim 1, wherein the substrate serves as a gate for the field-effect transistor.

23. (Previously Presented) The fluid sensor of claim 1, wherein the field-effect transistor includes a gate electrically insulated from the substrate.

24. (Previously Presented The fluid sensor of claim 1, wherein the functionalized semiconductor nano-wire comprises a conductive catalyst electrically insulated from the substrate to provide a gate for the field-effect transistor.

Claims 25 - 26. (Cancelled).

27. (Original) A fluid-sensor array, each fluid sensor of the fluid-sensor array comprising the fluid sensor of claim 1.

28. (Cancelled).

29. (Original) The fluid-sensor array of claim 27, wherein the field-effect transistor of each fluid sensor of the array is functionalized for detecting a particular substance.

30. (Original) The fluid-sensor array of claim 27, wherein the field-effect transistor of each fluid sensor of the array is functionalized for detecting a distinct substance.

31. (Original) The fluid-sensor array of claim 27, wherein the field-effect transistors of a number of the fluid sensors of the array are functionalized for detecting the same substance.

Claims 32-55 (Cancelled).

56. (Previously Presented) A fluid sensor on a substrate for use in an environment having an ambient temperature, the fluid sensor comprising:

a) a field-effect transistor (FET) comprising a functionalized semiconductor nano-wire, the functionalized semiconductor nano-wire including at least one coating, the coating including a substance capable of interacting with a fluid to be sensed and effecting a change of an electrical characteristic of the FET,

b) a control device on the substrate comprising a non-functionalized semiconductor nano-wire otherwise identical to the FET,

c) an integral heater disposed proximate to the field-effect transistor to heat the field-effect transistor to an elevated temperature relative to the ambient temperature,

d) an integral temperature sensor configured to allow control and selection of temperatures for at least one of calibration and setting of gas sensitivity; and

e) integral thermal insulation disposed on the substrate to maintain the field-effect transistor a the elevated temperature, wherein selection of the FET operating temperature by measurement of the integral temperature sensor, a particular fluid may be detected.

57. (Previously Presented) The fluid sensor of claim 56, wherein the coating comprised at least one dielectric layer of an oxide or a nitride that can be protonated or deprotonated for the detection of protons.

58. (Previously Presented) The fluid sensor of claim 56, wherein the coating comprises at least one organic species selected from the list consisting of antibodies, antigens, polymers, polynucleic acids, polypeptides, nanoparticles, ion exchange membranes, and combinations thereof.

59. (Previously Presented) The fluid sensor of claim 56, wherein the coating comprises at least one substance selected from the list consisting of thiols, amines, silanols, alcohols, sugars, Lewis acids, Lewis bases, dipoles, nucleic acids, peptides, and combinations thereof.

Evidence Appendix

(No evidence was submitted pursuant to Rules 130, 131, and 132, and therefore, this section is blank.)

Related Proceedings Appendix

(There are no related proceedings to this patent application, and therefore, this section is blank.)